PFB366
Profibus-DP
Gateway
User Manual

PFB366 – 1 isolated RS232 channel

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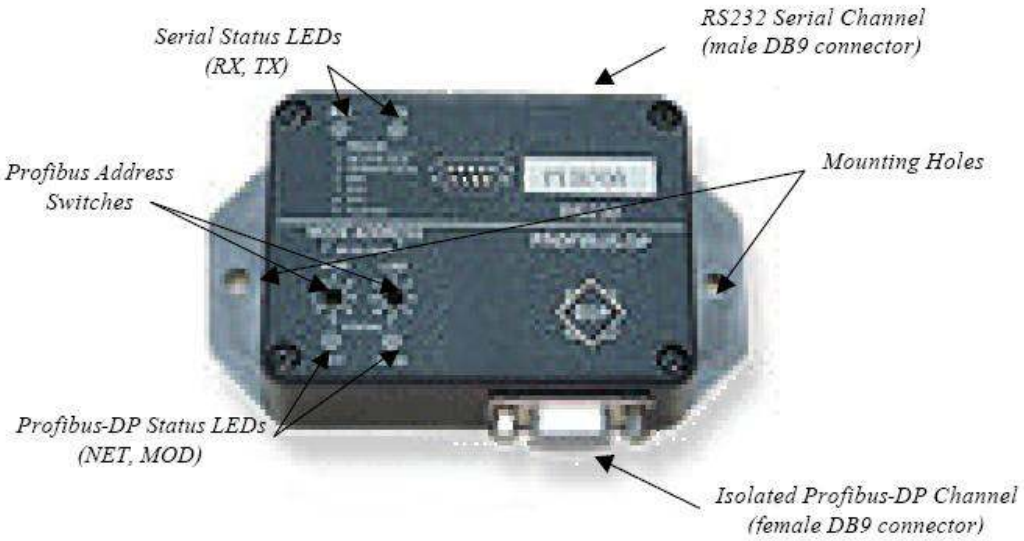
Chapter 1 – Overview

This document describes how to install, configure, and operate the PFB366 Profibus-DP serial gateway. The following products are covered in this user manual:

Part Number	Serial Channel
PFB366	RS232 full duplex

The PFB366 gateways allow you to easily interface a wide variety of serial devices to any Profibus-DP industrial control network. Each gateway contains the feature-packed D.I.P. gateway core. Standard PFB366 products are tightly packaged and sealed in a rugged industrial case. Board-level and customized gateways are also available upon request.



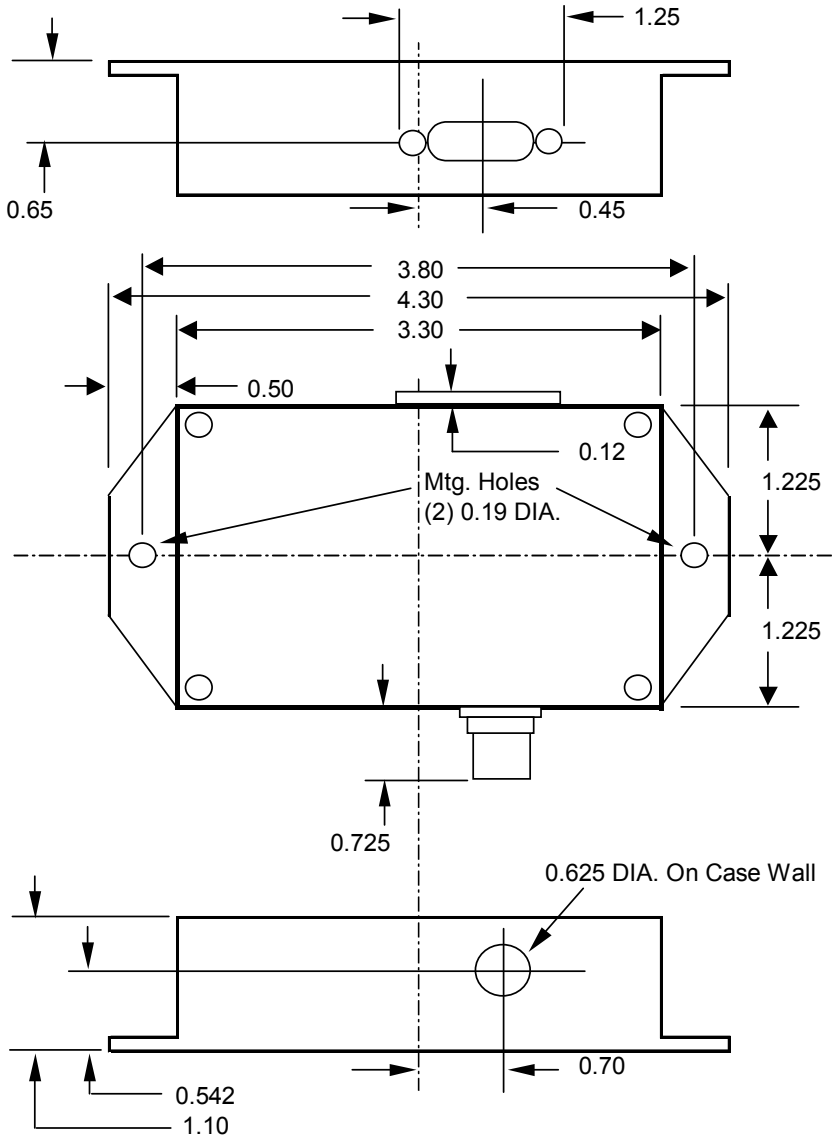
Product Features	PFB366
• Fully isolated Profibus channel	X
• 9600, 19.2K, 93.75K, 187.5K, 1.5M, 3M bps Profibus data rates (auto-baud)	X
• 2 rotary Hex ID switches for Profibus address	X
• RS232 serial channel with RTS/CTS flow control	X
• XON/XOFF software flow control	X
• 300, 1200, 2400, 4800, 9600, 19200 bps serial data rates	X
• Configurable data bits, stop bits, parity	X
• 255 byte transmit and receive FIFO buffers	X
• Powered by wide range 11-28VDC (external power supply)	X
• Loss-of-ground protection circuitry	X
• 4 bi-color status LEDs	X
• Encapsulated circuit board in compact industrial case	X

Chapter 2 – Installation

This chapter describes how to install and connect the PFB366 gateway to a Profibus-DP network and your serial device.

Mounting

Mount on a horizontal or vertical surface. While the RTV encapsulation protects its circuitry, the PFB366 DB9 connector is not rated for NEMA4 / IP65 environments. Mount the gateway in a suitable location or enclosure for your application. The gateway will generate up to 1.4W of heat, so provide sufficient clearance and airflow to maintain 0°C to 70°C operating temperature range. Use two screws (not provided) in the 0.19 inch mounting holes shown below to fasten the PFB366 to the mounting surface.



All dimensions are inches

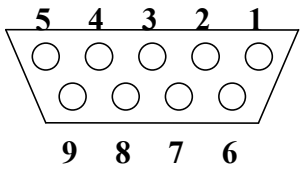
Wiring

The PFB366 requires two connections – one to the Profibus-DP network (female DB9 connector) and one to the target serial device (male DB9 connector). Follow all applicable electrical codes in your area when mounting and wiring any electrical device.

All power is received from an external 11-28VDC power supply connected to the serial channel DB9 connector. The PFB366 draws up to 50mA from the power supply. Select your serial and Profibus-DP cables and power supply so that it can provide sufficient current for all networked devices at their peak operating power.

Profibus-DP Interface

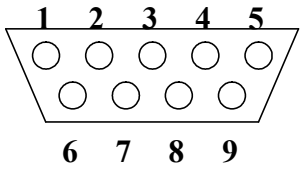
Female DB9 Profibus Connector



PIN	SIGNAL	DESCRIPTION
1	NC	No Connect. Do not connect any wires to NC pins.
2	NC	No Connect.
3	B	Non-Inverting input/output communication signal from Profibus.
4	RTS	Profibus-DP Request-To-Send output signal (repeater control).
5	GND	Isolated ground.
6	+5VDC	Isolated +5VDC supply.
7	NC	No Connect.
8	A	Inverting input/output communication signal from Profibus.
9	NC	No Connect.

Serial Channel Interface

Male DB9 Serial Connector

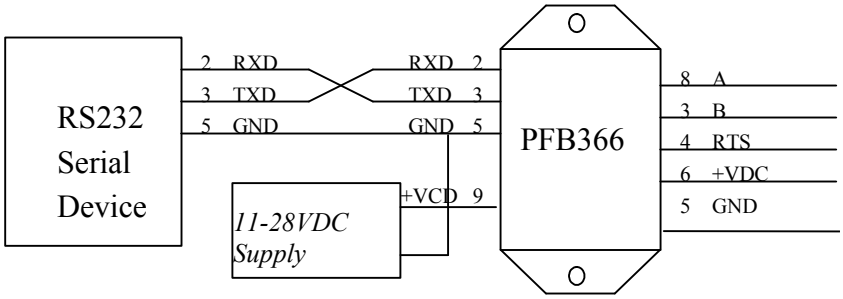


PIN	SIGNAL	DESCRIPTION
1	NC	No Connect. Do not connect any wires to NC pins.
2	RXD	Receive Data. RS232 input signal.
3	TXD	Transmit Data. RS232 output signal.
4	NC	No Connect.
5	GND	Ground. Common for RS232 signals.
6	NC	No Connect.
7	RTS	Request To Send. RS232 output signal.
8	CTS	Clear To Send. RS232 input signal.
9	NC	No Connect.

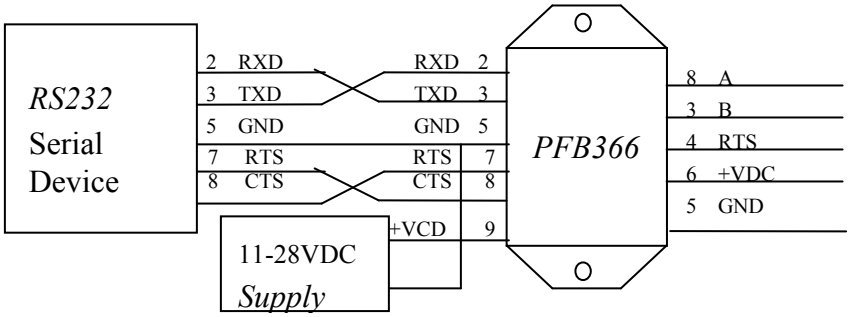
Wiring Examples

The following are typical PFB366 gateway wiring configurations. Your RS232 or RS422/485 interface may vary. Refer to your device's documentation for the required data and control signals.

Simple RS232 Interface



RS232 Interface, HW Flow Control

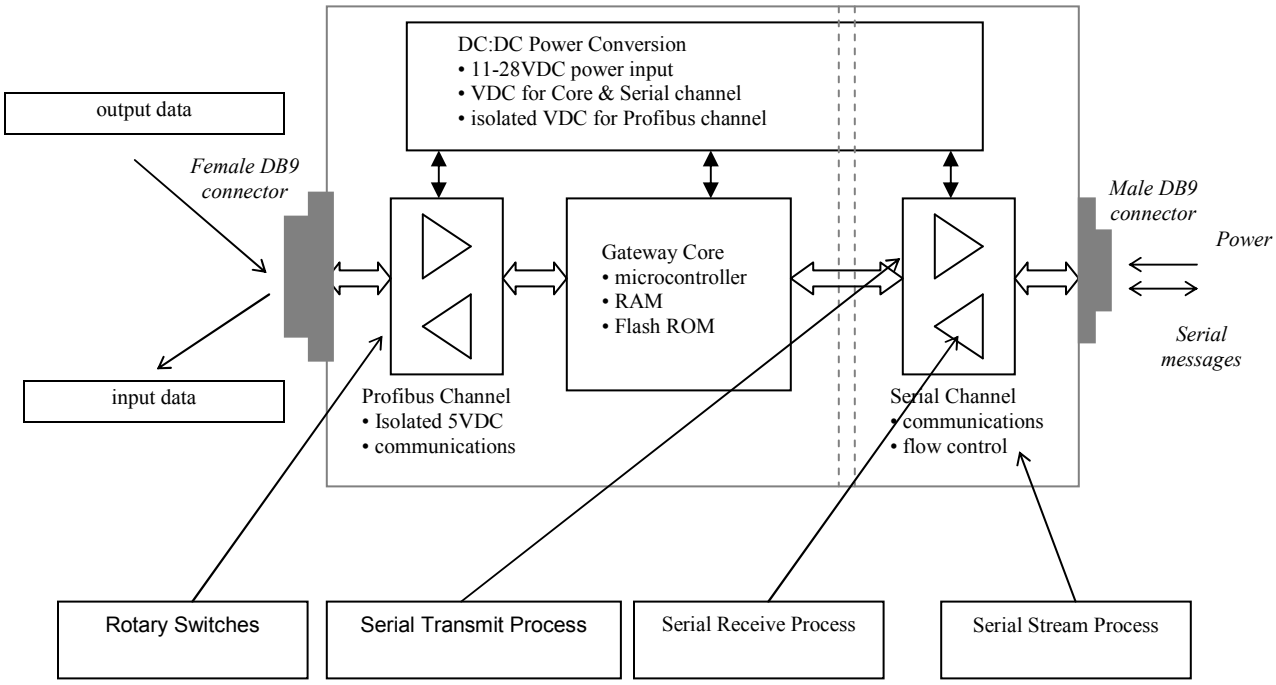


Chapter 3 – Theory of Operation

This chapter describes how the PFB366 gateway operates. You should have a working knowledge of Profibus-DP and asynchronous serial communications before continuing. Refer to your serial device documentation for its protocol information.

Gateway Operation

The PFB366 gateway receives asynchronous serial messages over its serial channel, converts them to data values, and returns the values as input data to the Profibus master. The gateway receives output data from the Profibus master, converts them into serial messages, and transmits the messages out its serial channel. The following diagram shows the major gateway components.



Configures the Profibus interface.

Converts output data from Profibus master into a message packet. Transmits message packet out the serial channel.

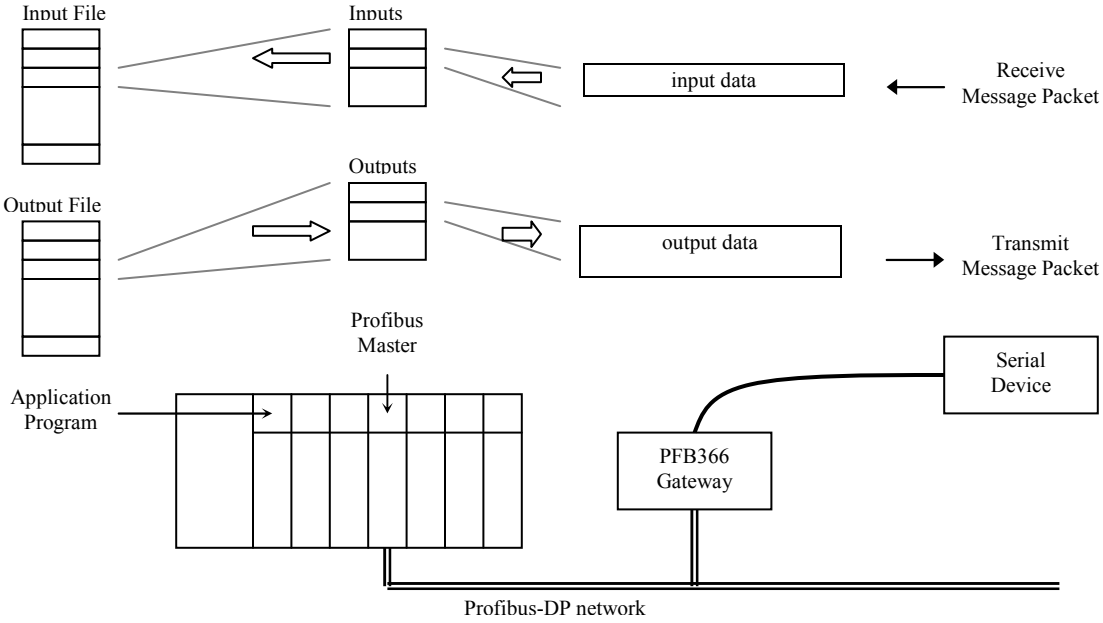
Converts received message packet to input data. Input data returned to Profibus master.

Configures the serial channel. Scan channel for valid message packets, which are passed to Serial Receive Process.

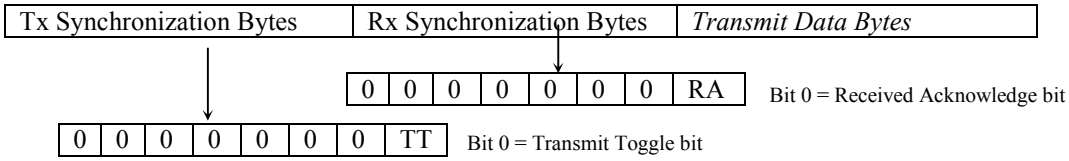
Profibus-DP Interface

The PFB366 gateway operates as a Profibus-DP slave. The Profibus master cyclically polls the gateway, sending output data and reading input data.

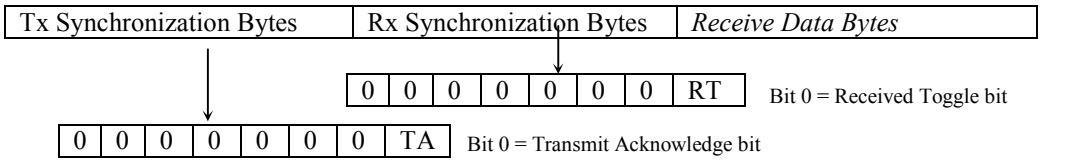
The output and input data bytes are typically mapped into data files inside the Profibus-DP master. These data files are exchanged with the user application program, which acts upon the received input data and writes new output data to the Profibus master.



The first 2 output data bytes received from the Profibus-DP master contain synchronization bits for the gateway transmit and receive operations. The remaining output data bytes contain serial message data to be transmitted out the serial channel.


Tx Synchronization Bytes
Rx Synchronization Bytes
Transmit Data Bytes
0 0 0 0 0 0 0 RA
Bit 0 = Received Acknowledge bit
0 0 0 0 0 0 0 TT
Bit 0 = Transmit Toggle bit

The first 2 input data bytes sent from the gateway contain synchronization bits for the gateway transmit and receive operations. The remaining input data bytes contain serial message data that has been received and processed by the gateway


Tx Synchronization Bytes
Rx Synchronization Bytes
Receive Data Bytes
0 0 0 0 0 0 0 RT
Bit 0 = Received Toggle bit
0 0 0 0 0 0 0 TA
Bit 0 = Transmit Acknowledge bit

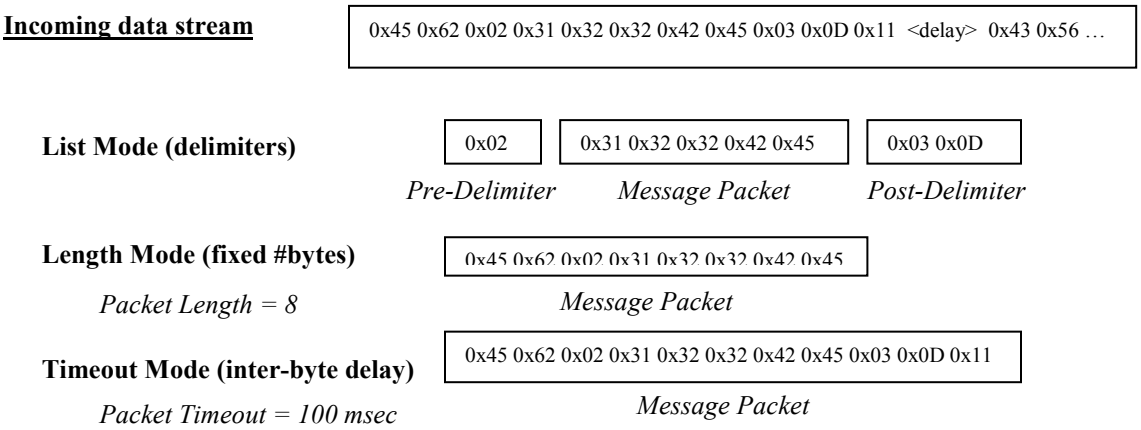
Serial Channel Interface

The PFB366 serial channel consists of an asynchronous serial transmitter and receiver. The serial interface is configured and controlled by the *Serial Stream Process* parameters, *Serial Receive Process* parameters, and *Serial Transmit Process* parameters.

Serial Stream Process

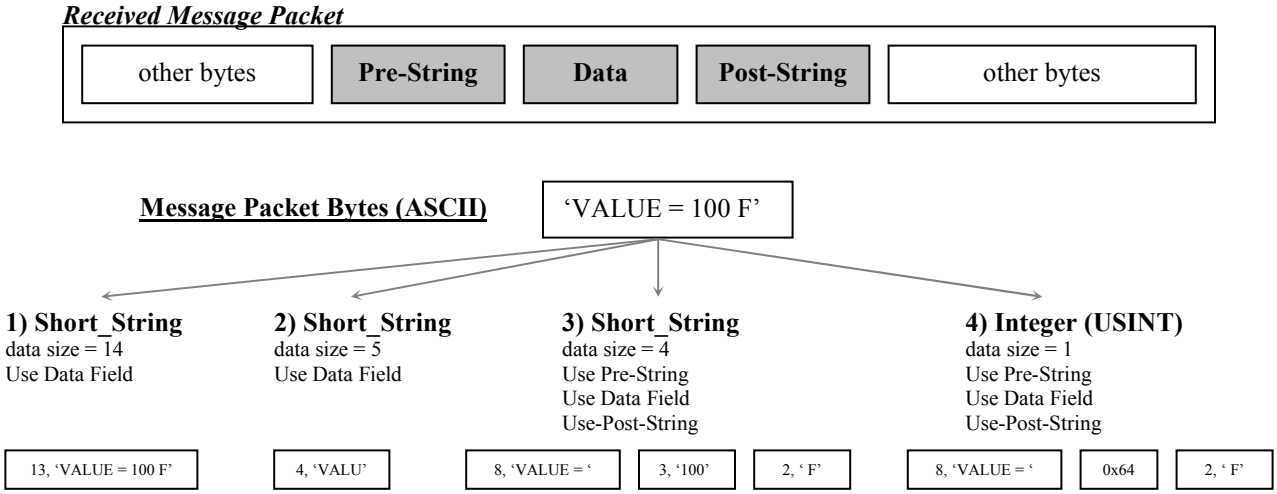
The *Serial Stream Process* parameters configure the serial channel's baud rate, number of data bits and stop bits, parity, and flow control. This configuration applies to both the serial transmitter and receiver. The gateway has separate 255-byte serial transmit and receive FIFO buffers, allowing full duplex operation when supported by the physical layer media.

The *Serial Stream Process* also scans incoming serial data for valid message packets. A message packet is determined by one of three *Delimiter* modes. *List* mode searches for *Pre-Delimiter* and *Post-Delimiter* byte strings at the beginning and end of a message. *Length* mode captures a specific number of message bytes, defined by *Packet Length*. *Timeout* mode uses an inter-byte delay (*Packet Timeout*) to signal the end of a message. When a message packet is received, it is processed by all enabled *Serial Receive Process*. The following examples show the three *Serial Stream Process Delimiter* modes.


Incoming data stream
0x45 0x62 0x02 0x31 0x32 0x32 0x42 0x45 0x03 0x0D 0x11 <delay> 0x43 0x56 …
List Mode (delimiters)
0x02
0x31 0x32 0x32 0x42 0x45
0x03 0x0D
Pre-Delimiter
Message Packet
Post-Delimiter
Length Mode (fixed #bytes)
Packet Length = 8
Message Packet
Timeout Mode (inter-byte delay)
0x45 0x62 0x02 0x31 0x32 0x32 0x42 0x45 0x03 0x0D 0x11
Packet Timeout = 100 msec
Message Packet

Serial Receive Process

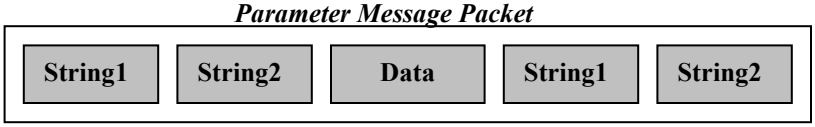
The *Serial Receive Process* processes the Message Packet bytes, converting them into an input data value that is returned to the Profibus master. The Message Packet bytes can be converted into a *Short_String* data type (byte array, with 1st byte = length). ASCII characters within the Message Packet representing a numerical value can also be converted into signed or unsigned integer or real number data types. The *Serial Receive Process* can be configured to search for *Pre-String* and/or *Post-String* byte strings at the beginning and/or end of the desired data bytes. The data bytes framed by the *Pre-String* and *Post-String* bytes are then converted into a Short_String, integer, or real number. The following examples show how the *Serial Receive Process* can be configured to process a Message Packet.



Serial Transmit Process

The *Serial Transmit Process* receives an output data value from the Profibus master. It converts the output data into a serial message packet to transmit out the serial channel. The output data format can be a *Short_String* (byte array, with 1st byte = length), a signed or unsigned integer, or a real number data type. An integer or real number can be converted into ASCII characters that represent the numerical value before it is transmitted. *String1* and *String2* character strings can be placed before and/or after the converted data in the message packet, allowing you to build and transmit complex messages. The following examples show how the *Transmit Serial Process* can be configured to convert a data value into a message packet.

Parameter Message Packet



1) *Output Data Bytes*

0x03 0x41 0x42 0x43

Short_String, data size = 4.
Use Data Field.
[0x41 0x42 0x43] = 'ABC'

Transmitted Message Packet

'ABC'

2) *Output Data Byte*

0x08

USINT integer, data size = 1,
width = 1, conversion = D.
Use Data Field.
[0x08] → '8' (0x38)

Transmitted Message Packet

'8'

3) *Output Data Bytes*

0xFF 0x47

INT integer, data size = 2,
width = 4, conversion = D.
Use String1 Before [0x06, 'VAL = '].
Use Data Field.
Use String2 After [0x02, ' F'].
[0xFF 0x47] = -185 → '-185'

Transmitted Message Packet

'VAL = -185 F'

Asynchronous Serial Communictaion

Devices communicating on an asynchronous serial link exchange information one bit at a time. Each bit is transmitted for a specific period of time, defined by the baud rate. Devices use internal timing circuitry to measure the baud rate. There is no clocking signal between devices to synchronize the serial data flow, hence the term *asynchronous* serial communications.

Serial data bits are organized into bytes. When a data byte is asynchronously transmitted, it is preceded by a start bit, followed by the data bits, an optional parity bit, and one or more stop bits. There can be a variable transmission delay between successive serial data bytes, since each byte is framed by its own start and stop bits. The receiver starts saving serial bits after is receives a valid start bit (0), and stops when it receives the expected number of stop bits (1). The data byte's least-significant bit is transmitted first (data bit 0), and the most-signficant bit is transmitted last (data bit N).

[start bit] [data bit 0] [data bit 1] … [data bit N] [optional parity bit] [stop bit(s)]

The parity bit is used to detect single-bit errors in the transmission. The parity bit is automatically calculated and inserted by the transmitter. The receiver calculates the parity of an incoming byte, and compares it to the parity bit sent by the transmitter. If the two bit values do not match, then at least one serial bit value was corrupted during transmission.

Flow control allows the receiving device to regulate the rate of incoming data. Hardware flow control uses RTS/CTS signals between the devices to control the rate of transmission. Software flow control uses serial characters XON/OFF to control the rate. Flow control helps protect against lost data, if the receiving device cannot store incoming data fast enough, or if the receiving device's buffer is full and cannot accept more data until it processes existing data.

Data Conversion

The PFB366 gateway can either pass through received serial message bytes to your application, or pre-process an ASCII string into a numerical value. The gateway can transmit a string of message bytes sent by the application, or it can convert a numerical value into an ASCII string to be transmitted. Using the gateway's data conversion feature offloads this cumbersome task from your application program, especially if it is a PLC ladder-logic application. It also reduces the required number of Profibus input and output bytes, since converted values instead of entire message strings are transferred over Profibus.

The gateway conversion process supports the following data types:

Data Type		Data Size	Value Range
SINT	signed 8-bit integer	1	-128 to 127
INT	signed 16-bit integer	2	-32768 to 32767
USINT	unsigned 8-bit integer	1	0 to 255
UINT	unsigned 16-bit integer	2	0 to 65535
REAL	32-bit floating point	4	±1.175E-38 to ±3.4028E+38
Short_String	(byte array)	2 to 26	string of bytes, 1st byte defines length

The *Serial Transmit Process* and *Serial Receive Process* parameters configure the conversion process for transmitted and received messages. The *Data Type* parameter selects the desired data

type for the *Receive Data* or *Transmit Data* value. The *Data Size* parameter represents the number of bytes used by the selected data type. You must select the maximum data size expected for your application if using the Short_String data type. The Short_String byte array format is a length byte followed by data bytes, so you must add one to the expected number of bytes. The table above defines the data size for all other data types.

The PFB366 gateway supports a maximum of 28 bytes for the *Transmit Data* value and 28 bytes for the *Receive Data* value.

The *Width* parameter defines the number of ASCII bytes (1 to 16) used to represent a real or integer number. For received messages, *Width* defines the number of ASCII bytes that will be converted into a number. For transmitted messages, *Width* defines how many ASCII bytes will be generated to represent the number. The *Width* value must include ASCII sign (+/-), exponent (E), and decimal point (.) characters. *Width* is not used for Short_String data types.

The *Precision* parameter is only used for transmitted messages. It defines the number of digits (1 to 6) after the decimal point for a floating-point number. The gateway will automatically add trailing zeros to the converted number if needed. *Precision* is only used for the REAL data type.

The following examples show how to calculate the *Data Size*, *Width*, and *Precision* parameters for the different *Data Types*. Remember to add a length byte to the Short_String *Data Size*.

Data Type	ASCII chars	*Data Size*	*Width*	*Precision*
SINT	'-12'	1	3	not used
INT	'-12345'	2	6	not used
USINT	'123'	1	3	not used
UINT	'1234'	2	4	not used
REAL	'1.23E+4'	4	7	2
REAL	'-1.1234E-12'	4	11	4
Short_String	'ABCDEF'	7 (length=6)	not used	not used

The *Conversion* parameter is different for *Serial Receive Process* and *Serial Transmit Process*. For the *Serial Receive Process*, the *Conversion* parameter denotes if the ASCII bytes represent a decimal integer or a hexadecimal integer. If decimal is selected, then the gateway converts the ASCII bytes as a decimal number. If hexadecimal is selected, then the gateway converts the ASCII bytes as a hex number.

'1234' → If decimal, integer = 1234.
'1234' → If hexadecimal (0x1234), integer = 4660.

For the *Serial Transmit Process*, the *Conversion* parameter also denotes if the ASCII bytes represent a decimal or hexadecimal integer. If decimal is selected, then the gateway converts the integer into a decimal ASCII representation. If hexadecimal is selected, then the gateway converts the integer into a hex ASCII representation.

Integer = 1234 → If decimal, ASCII representation = '1234'
Integer = 1234 → If hexadecimal, ASCII representation = '04D2'

The *Serial Transmit Process Conversion* parameter can also be used to insert leading zeros into a converted number. If the ASCII representation of a number contains fewer characters than the selected *Width*, then leading zeros can added in front of the number.

Integer = 1234, Width = 7 → If leading zeros enabled, ASCII representation = '0001234'
Integer = 1234, Width = 7 → If leading zeros disabled, ASCII representation = '1234'

The following examples show a variety of different gateway data conversions for received and transmitted data values.

Example 1 – Data Type = Short_String, Data Size = 9
Received ASCII data is '12345678'. The *Serial Receive Process* parameter coverts this to 9 bytes of *Receive Data*, [0x08, 0x31, 0x32, 0x33, 0x34, 0x35, 0x36, 0x37, 0x38] or [0x08, '12345678']. The first byte defines the *Short_String* length as 8 bytes.

Example 2 – Data Type = Short_String, Data Size = 5
Received ASCII data is '12345678'. The *Serial Receive Process* Parameter converts this to 4 bytes of *Receive Data*, [0x04, 0x31, 0x32, 0x33, 0x34] or [0x04, '1234']. The first byte defines the *Short_String* length as 4 bytes. With *Data Size* = 5, only the first 4 data bytes are used.

Example 3 – Data Type = Short_String, Data Size = 12
Received ASCII data is 'ABCDEFGH'. The *Serial Receive Process* Parameter converts this to 9 bytes of *Receive Data*, [0x08, 0x41, 0x42, 0x43, 0x44, 0x45, 0x46, 0x47, 0x48] or [0x08, 'ABCDEFGH']. The first byte defines the *Short_String* length as 8 bytes. Even though *Data Size* = 12, only the 8 received bytes are returned.

Example 4 – Data Type = SINT, Width = 5, Conversion = Hex
Received ASCII data is '18'. The *Serial Receive Process* Parameter converts this to 1 byte of *Receive Data*, [0x18].

Example 5 – Data Type = INT, Width = 4, Conversion = Decimal
Received ASCII data is '-25'. The *Serial Receive Process* Parameter converts this to 2 bytes of *Receive Data*, [0xFF 0xE7]. The ASCII '-25' decimal number converts to 0xFFE7.

Example 6 – Data Type = REAL, Width = 13
Received ASCII data is '-1.2345E-16'. The *Serial Receive Process* Parameter converts this to 4 bytes of *Receive Data*, [0xNN, 0xNN, 0xNN, 0xNN]. This is the 32-bit floating-point representation for '–1.2345E-16'.

Example 7 – Data Type = REAL, Width = 7
Received ASCII data is '-1.2345E-16'. The *Serial Receive Process* Parameter converts this to 4 bytes of *Receive Data*, [0xNN, 0xNN, 0xNN, 0xNN]. This is the 32-bit floating-point representation for '-1.2345'. With *Width* = 7, only the first 7 ASCII bytes are converted.

Example 8 – Data Type = Short_String, Data Size = 8
Transmit Data is [0x08, 0x31, 0x32, 0x33, 0x34, 0x35, 0x36, 0x37, 0x38]. The *Serial Transmit Process* Parameter converts this into 8 ASCII bytes '12345678'. Note the first *Transmit Data* byte defines the *Short_String* length in bytes. This length byte is not transmitted.

Example 9 – Data Type = SINT, Width = 5, Conversion = Hex, Leading Zeros
Transmit Data is [0x18]. The *Serial Transmit Process* Parameter converts this into 5 ASCII bytes '00018'. Leading zeros are added to match the *Width* = 5.

Example 10 – Data Type = INT, Width = 6, Conversion = Decimal, No Leading Zeros
Transmit Data is [0xFF 0xE7]. The *Serial Transmit Process* Parameter converts this into the ASCII string

'-25'. The *Width* is 3 bytes greater than '-25', but leading zeros are not selected.

Example 11 – Data Type = REAL, Width = 13, Precision = 6, Conversion = No Leading Zeros
Transmit Data is [0xNN 0xNN 0xNN 0xNN], representing the real number –1.2345E-16. *The Serial Transmit Process* Parameter converts this into the ASCII string '-1.234500E-16'. The *Precision* is 2 bytes greater than needed, so trailing zeros are added after the decimal point.

Serial Receive Example

The following example shows how the PFB366 gateway captures a serial message packet, processes the packet, converts the data into a number, and returns it as a Profibus input value.

The gateway's *Serial Stream Process* is configured for the *List* delimiter mode, with a one-byte *Pre-Delimiter* string and a two-byte *Post-Delimiter* string. An incoming message must have matching delimiter strings to be accepted as a valid message packet.

The *Serial Receive Process* has the *Use Pre-String*, *Use Data*, and *Use Post-String* options selected for its *Receive Mode*. The message packet must have matching *Pre-String* and *Post-String* values before the data is processed. The *Data Type* is configured for SINT, with a *Width* of 2 and *Conversion* set for decimal. The data field's two-byte ASCII string represents a decimal number, which is converts into an 8-bit signed integer. The converted number is saved as the new *Receive Data* value. The gateway also toggles its *Receive Toggle* bit to signal the reception of new data.

When the gateway is polled for input data, it returns the *Transmit Acknowledge* byte, *Receive Toggle* byte, and *Receive Data* byte(s). The *Transmit Acknowledge* bit is mapped to bit 0 in the first byte. The *Receive Toggle* bit is mapped to bit 0 of the second byte. The *Receive Data* value makes up the rest of the input bytes. The Profibus master passes these input bytes for the application program.

The user application receives the updated gateway inputs. Program logic recognizes the state change in the *Receive Toggle* bit, indicating that gateway has sent new input data. To acknowledge that it has read the new data, the user application toggles the *Receive Acknowledge* bit, which gets sent back to the gateway by the Profibus master. When the *Serial Receive Process* gets the updated *Receive Acknowledge* bit, it can then process the next incoming serial message.

Serial Receive Process

1) Serial Device transmits message.
   Serial Data (ASCII) <STX> T E M P <SP> = <SP> **6** **4** <SP> C <CR> <ETX>
   Serial Data (hex) 0x02 0x54 0x45 0x4D 0x50 0x20 0x3D 0x20 **0x36 0x34** 0x20 0x43 0x0D 0x03

2) *Serial Stream Process* receives message and loads into rx buffer without delimiters.
   Delimiter Mode = List
   Pre-Delimiter = [0x01 0x02]
   Post-Delimiter = [0x02 0x0D 0x03]
   0x54 0x45 0x4D 0x50 0x20 0x3D 0x20 **0x36 0x34** 0x20 0x43

3) *Serial Receive Process* processes message packet.
   Pre-String = [0x07, 'TEMP = ']
   Data = ['64']
   Post-String = [0x02, ' C']
   0x54 0x45 0x4D 0x50 0x20 0x3D 0x20 | **0x36 0x34** | 0x20 0x43

4) ASCII data to *Data Type* value.
   Data Type = SINT, Width = 2, Conversion = D
   0x36 0x34 ⇒ '64'⇒ 64 decimal ⇒ 0x40 hex
   0x36 0x34
   0x40

5) *Receive Data* value sent to Profibus master.
   PROFBUS INPUT DATA BYTES
   TA = Transmit Acknowledge byte
   RT = Receive Toggle bits (bit0 toggled 0-1)
   0x40 = Receive Data
   TA | RT=xxxxxxx**1** | **0x40**

6) Application acknowledges reading new *Receive Data*.
   PROFIBUS OUTPUT DATA BYTES
   TT = Transmit Toggle byte
   RA = Receive Acknowledge byte (bit 0 set to 1)
   TT | RA=xxxxxxx**1** | Tx Data

Serial Transmit Example

The following example shows how the PFB366 gateway receives Profibus output data, converts the data into an ASCII string, then builds and transmits a serial message using the converted string.

The gateway receives new output data from the Profibus master. The first output byte contains the *Transmit Toggle* bit (bit 0). The second byte contains the *Receive Acknowledge* bit (bit 0). The remaining data bytes are the *Transmit Data* value. In this example, *Serial Transmit Process* receives a toggled *Transmit Toggle* bit, indicating the application has sent a new *Transmit Data* value to the output bytes.

Serial Transmit Process is configured for SINT *Data Type*, with *Width* of 2 and *Conversion* set for decimal with no leading zeros. It converts its new *Transmit Data* value 0x52 into the ASCII string '82'. The *Transmit Mode* parameter is set for *String1 Before, Data,* and *String2 After*. The resulting serial message that gets loaded into the gateway transmit buffer consists of [String1, '82', String2]. The message will be sent when the serial channel transmitter is available.

When the new message is loaded in the transmit buffer, the gateway toggles its *Transmit Acknowledge* bit, indicating that is it ready to receive the next *Transmit Data* value. The updated *Transmit Acknowledge* bit is read by the application as an input byte. There may have been subsequent Profibus read/write cycles in between the time the gateway received the new *Transmit Data* value and the time it toggles its *Transmit Acknowledge* bit.

Serial Transmit Process

1) *Transmit Data* received from Profibus master.
   PROFIBUS OUTPUT BYTES
   TT = Transmit Toggle byte (bit 0 toggled 0-1)
   RA = Receive Acknowledge byte (bit 0)
   0x52 = Transmit Data

   TT=00000001 | RA | **0x52**

2) *Serial Transmit Process*converts data to ASCII.
   Data Type = SINT, Width = 2, Conversion = D
   0x52 hex → 82 decimal → '82' or [0x38 0x32]

   0x52
   0x38 0x32

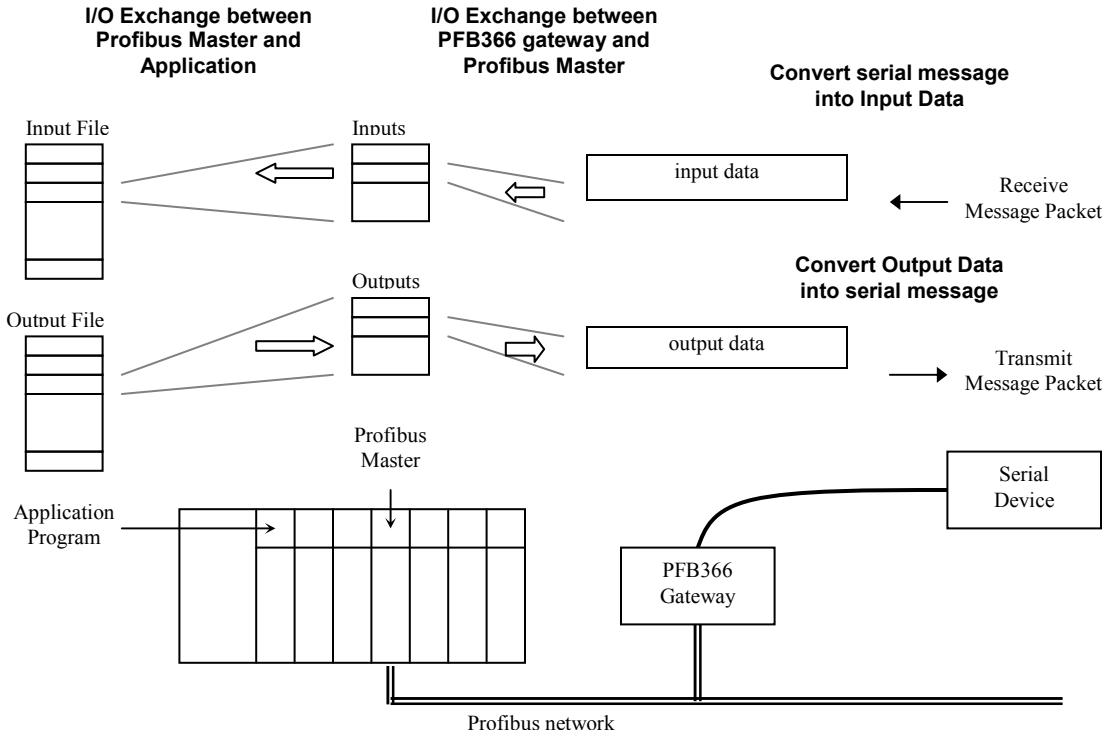
3) Builds message & loads into transmit buffer.
   String1 = [0x09 0x02 'SET T = ']
   Data = ['82']
   String2 = [0x04 ' C' 0x0D 0x03]

   0x02 0x53 0x45 0x54 0x20 0x54 0x20 0x3D 0x20 | 0x38 0x32 | 0x20 0x43 0x0D 0x03

4) Gateway transmits message.
   Serial Data Stream (hex bytes) 0x02 0x53 0x45 0x54 0x20 0x54 0x20 0x3D 0x20 0x38 0x32 0x20 0x43 0x0D 0x03
   Serial Data Stream (ASCII) <STX> S E T <SP> T <SP> = <SP> 8 2 <SP> C <CR> <ETX>

Synchronization

There are four independent processes operating in a PFB366 gateway application. The first process is the exchange of input and output data between the user application program and the Profibus master. The second process is the exchange of input and output data between the gateway and Profibus master, using read and write over Profibus. The third process is receiving serial messages and converting it to input data. The fourth process is converting output data and transmitting it as serial messages. To ensure that no information is lost between the gateway's serial channel and the user application program, the PFB366 incorporates a receive synchronization feature and a transmit synchronization feature.

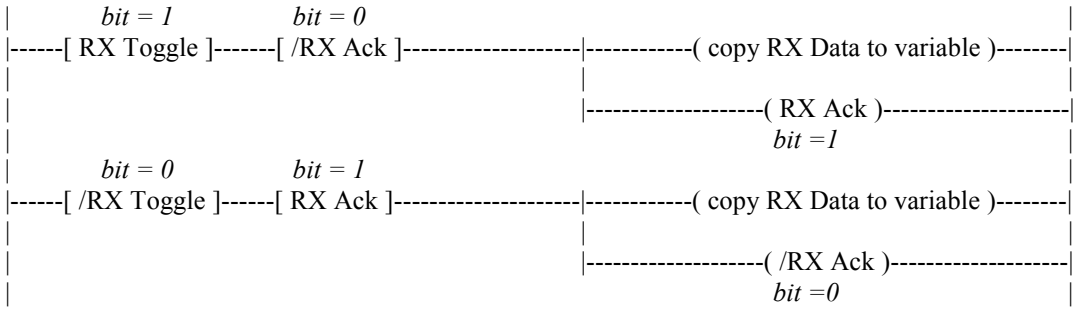


Receive Synchronization

The gateway receive synchronization feature is optional for *Serial Receive Process*. It is enabled by the *Sync Enable* parameter. When enabled, the gateway will not process a new message packet until the last *Receive Data* value has been read and acknowledged by the application program. When a *Serial Receive Process* updates its *Receive Data* value, it also toggles its *Receive Toggle* bit to indicate a new data value is available. The user application monitors the *Receive Toggle* bit, and reads the *Receive Data* value when the bit changes state. Once the application has read and processed or stored the new *Receive Data* value, it acknowledges receipt by setting the *Receive Acknowledge* bit equal to the *Receive Toggle* bit. The gateway is now able to start processing the next serial message packet. The *Receive Toggle* and *Receive Acknowledge* bits are set to 0 at power-up.

The *Receive Acknowledge* bit maps to bit 0 in the second byte of the Profibus output data. *The Receive Toggle* bit maps to bit 0 in the second byte of the Profibus input data. This bit mapping

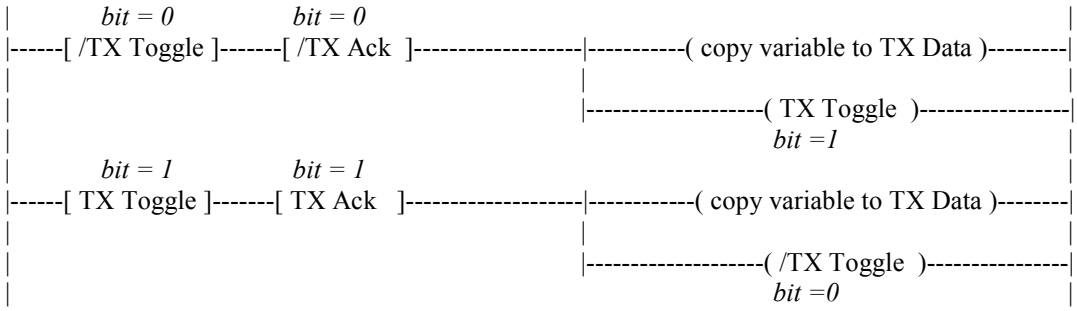
makes it easy for ladder-logic applications to implement the gateway's receive-synchronization process. The following 2 ladder-logic rungs show how an application program can monitor for the gateway's *Receive Toggle* bit, copy the new *Receive Data* value to save it, and set the *Receive Acknowledge* bit equal to the *Receive Toggle* bit



Transmit Synchronization

The gateway transmit synchronization is always enabled *Serial Transmit Process*. The gateway will not process its *Transmit Data* output bytes until its *Transmit Toggle* bit changes state. When the user application sends new *Transmit Data* to the gateway, it must toggle the *Transmit Toggle* bit. This enables the gateway to process the new output value and load the resulting serial message into the transmit buffer. When the message is loaded for transmission, the gateway acknowledges transmission by setting its *Transmit Acknowledge* bit equal to the *Transmit Toggle* bit. The application can now send the next *Transmit Data* value. The *Transmit Toggle* and *Transmit Acknowledge* bits are set to 0 at power-up.

The *Transmit Toggle* bits maps to bit 0 in the first byte of the Profibus output bytes. The *Transmit Acknowledge* bit maps to bit 0 in the first byte of Profibus input bytes. This bit mapping makes it easy for ladder-logic applications to implement transmit synchronization. The following 2 ladder-logic rungs show how an application program writes the gateway's *Transmit Data* value, toggles the *Transmit Toggle* bit, and waits for the *Transmit Acknowledge* bit to equal the *Transmit Toggle* bit before writing the next *Transmit Data* value.



Chapter 4 – Gateway Configuration

This chapter describes how to configure and operate the PFB366 gateway. You configure the gateway by reading and writing parameter values over its Profibus interface. There are a variety of Profibus configuration tools available. You can configure the gateway using the user interface defined in the gateway's GSD file.

Configure Profibus Interface

Set the Profibus Address using the rotary switches. Configure switches before connecting to the Profibus network. There is either a small triangular indicator or white indicator on the switch. Use a small screwdriver to align that indicator with the desired setting. Remove the PFB366 cover if necessary to access the rotary switches.

Node Address Switches

The two Node Address switches represent decimal numbers from 0x00 to 0xFF. The LSB switch selects the lower 4 bits (lower nibble) and the MSB switch selects the upper 4 bits (upper nibble) of the 8-bit hexadecimal address. Valid Node Addresses are 0x00 to 0x7D (0-125). Setting a Node Address greater than 0x7D forces the gateway to use the Node Address saved in retentive memory from previous power cycle. A valid Node Address must first be saved in the gateway before this feature can be used.

MSB	LSB	Address	MSB	LSB	Address
0	0 to F	00 to 15	8	0 to F	stored address
1	0 to F	16 to 31	9	0 to F	stored address
2	0 to F	32 to 47	A	0 to F	stored address
3	0 to F	48 to 63	B	0 to F	stored address
4	0 to F	64 to 79	C	0 to F	stored address
5	0 to F	80 to 95	D	0 to F	stored address
6	0 to F	96 to 111	E	0 to F	stored address
7	0 to D	112 to 125	F	0 to F	stored address
7	E,F	stored address			

Power Up Gateway

Connect the gateway to a Profibus network and apply power to the gateway.

Gateway Status LEDs

The PFB366 gateway has two bi-color status LEDs (*NET* and *MOD*) that indicate operational status. During power-up, the LEDs cycle through a sequence of alternating red and green. After power-up, the *NET* and *MOD* LEDs will be solid green if the slave has recognized the Profibus baud rate and entered its data exchange mode. If this does not occur, power down and verify all the switch settings, or proceed to download the database of PFB366 parameters.

State	Profibus Status LED (*NET*)
Off	Wait Parameter/Configuration State.
Flashing Red	Not Used.
Solid Red	Not Used.
Flashing Green	Wait Parameter/Configuration State.
Solid Green	Data Exchange (Normal runtime operation.)

State	Module Status LED (*MOD*)
Off	No power.
Flashing Red	Not Used.
Solid Red	Baud Search State. Auto-baud for Profibus baud rate.
Flashing Green	Not Used.
Solid Green	Baud Rate Found. Normal Operation.

Serial Channel Status LEDs

The gateway has two bi-color LEDs to indicate serial channel activity. The *TX* LED flashes green when a packet is being transmitted. The *RX* LED flashes green when a packet is being received. A fault is indicated by solid red. After power-up, both LEDs should be off.

State	Transmit Status LED (*TX*)
Off	No data being transmitted
Flashing Red	Not defined
Solid Red	Transmit error (parity or overrun error)
Flashing Green	Data being transmitted
Solid Green	Not defined

State	Receive Status LED (*RX*)
Off	No data being received
Flashing Red	Not defined
Solid Red	Receive error (parity or overrun error)
Flashing Green	Data being received
Solid Green	Not defined

Register GSD File

If using a Profibus configuration tool that supports GSD files, you should now register the gateway's GSD file with the software. The latest GSD file versions can be downloaded from *www.mksinst.com*. Select the GSD file that matches your gateway's part number and firmware version. Follow your configuration tool instructions to register GSD file.

Configure Serial Channel

The *Serial Stream Process* parameters control the physical layer settings for the PFB366 serial channel. These settings apply to all serial transmit and receive operations. The parameters also configure the reception of message packets. Before you can set or change any gateway configuration settings, make sure the gateway is not on line with the Profibus master.

Serial Stream Process Parameter Parameters (Parameter Group 64, Parameter Device 1)

Number	Name	Data Type	Value
3	Baud Rate	UDINT	300, 1200, 2400, 4800, 9600, 19200 bps
4	Data Bits	USINT	7, 8
5	Parity	USINT	0 = no parity 1 = odd parity 2 = even parity 3 = mark 4 = space
6	Stop Bits	USINT	1, 2
7	Flow Control	USINT	0 = none 1 = XON / XOFF 2 = CTS / RTS
10	Delimiter Mode	USINT	Bit 0 – List mode Bit 1 – Timeout mode Bit 2 – Length mode
11	Pre-Delimiter List	Short_String	List mode – String of 1-9 bytes.
12	Post-Delimiter List	Short_String	List mode – String of 1-9 bytes.
13	Packet Timeout	USINT	Timeout mode – delay between received bytes (1-255 msec).
14	Packet Length	USINT	Length mode – Number of message bytes (1-255).

Baud Rate – Sets the serial channel's data or baud rate. Enter *Baud Rate* in bits-per-second (bps) as a decimal number.

Data Bits – Selects the number of data bits in one serial byte. This number does not include start, parity, or stop bits.

Parity – Selects the parity type used in the serial byte. Selecting any parity option other than *NONE* adds 1 parity bit to the serial byte length.

Stop Bits – Selects the number of stop bits in one serial byte.
Flow Control – Selects the method of flow control used across the serial interface.

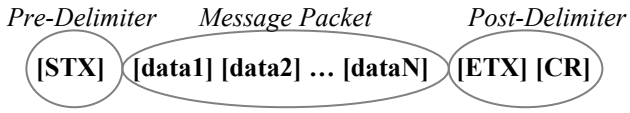
NONE means there is no flow control over the serial data exchange. The transmitting device can overflow the receiving device's buffer.

XON/XOFF is a software flow control option. Receiving device sends an XOFF character to the transmitting device when its buffer is full, stopping further transmission. It sends an XON character when it can again receive data. The XOFF and XON characters are not saved as message data.

CTS/RTS is an RS232 hardware flow control option, available only on the PFB366 gateway. The RTS is an output and CTS is an input signal. The gateway keeps RTS active (low) when it can receive data. It only transmits data when CTS is active (low).

Delimiter Mode – Defines how the gateway determines when it has received a message packet. The three delimiter modes are *List*, *Timeout*, and *Length*. Setting the appropriate bit in the *Delimiter Mode* byte selects the respective mode. The *Delimiter Mode* byte defines bits 0, 1, 2 only. Set the remaining bits 3 through 7 to zero.

List mode is used when a message packet is framed by a specific strings of *Pre-Delimiter* and *Post-Delimiter* bytes. The *Pre-Delimiter* signals the start of a new packet. The *Post-Delimiter* indicates the end of the packet. Each *Pre-Delimiter* and *Post-Delimiter* string can be from 1 to 9 bytes in length. When the gateway receives the *Pre-Delimiter* string, it saves the subsequent data bytes until the *Post-Delimiter* string is received. The *Pre-Delimiter* and *Post-Delimiter* bytes are not saved in the message packet. The following is a simple ASCII message example.



Length mode is used when every message packet contains the same number of bytes. The *Packet Length* parameter defines the packet size, from 1 to 255 bytes. The gateway saves serial bytes until it receives the specified number, and saves them as one message packet.

Timeout mode uses a delay between received data bytes to determine the end of a message packet. The *Packet Timeout* parameter defines the time-out period, from 1 to 255 milliseconds.

Pre-Delimiter List – Required for *List Mode*. Enter a string of 1 to 9 bytes that defines the start of a new serial message. Use Short_String data format, with 1st byte = string length. Example *Pre-Delimiter* is [0x01 0x02], where string length is 1 and delimiter character is 0x02 (STX).

Post-Delimiter List – Required for *List Mode*. Enter a string of 1 to 9 bytes that defines the end of a serial message. Use Short_String data format, with 1st byte = string length. Example *Post-Delimiter* is [0x02 0x0D 0x03], where string length is 2 and delimiter characters are 0x0D (CR) and 0x03 (ETX).

Packet Timeout – Required for *Timeout Mode*. Defines the timeout period between received bytes that indicates the end of a message packet (1-255 milliseconds).

Packet Length – Required for *Length Mode*. Defines the message packet size (1-255 bytes).

Serial Receive Process Settings

This section describes how to configure the *Serial Receive Process*.

Serial Receive Process Parameters (Parameter Group 65, Parameter Device 1)

Number	Name	Data Type	Value
6	Receive Mode	USINT	Bit 0 – use Data Field Bit 1 – use Pre-String Field Bit 2 – use Post-String Field
7	Pre-String	Short_String	String of 1-9 bytes.
8	Post-String	Short_String	String of 1-9 bytes.
9	Data Type	USINT	194 (0xC2) = SINT (1 byte) 195 (0xC3) = INT (2 bytes) 198 (0xC6) = USINT (1 byte) 199 (0xC7) = UINT (2 bytes) 202 (0xCA) = REAL (4 bytes) 218 (0xDA) = Short String (Data Size bytes)
10	Data Size	USINT	1-26
11	Width	USINT	1-16
13	Conversion	USINT	'D' (0x44) = decimal integer. 'X' (0x58) = hexadecimal integer.
14	Pad Char	CHAR	Pad byte value. Pad Poll Response if Rx data does not fill up Poll response message data.
17	Sync Enabled	BOOL	0 = disabled, 1 = enabled

Receive Mode – Defines how the gateway processes message packet bytes. The gateway can search for 3 fields – *Pre-String*, *Data*, and *Post-String*. Set associated bits (0, 1, 2) to use the desired fields. Set the remaining bits 3 through 7 to zero.

[Pre-String] [Data] [Post-String]

Pre-String parameter defines the byte string for the *Pre-String* field. *Data Size* parameter defines the number of bytes expected in the *Data* field. *Post-String* parameter defines the byte string for the *Post-String* field.

When *Use Pre-String* bit is set, the gateway searches the message packet bytes for a match to the stored *Pre-String*. If a match is not found, the message packet is ignored.

When *Use Data* bit is set, the gateway converts the *Data Size* number of message bytes into a value defined by *Data Type*, and saves it as *Receive Data*. If there are not enough message bytes, the message packet is ignored. You must select *Use Data* in order to send input data to the Profibus master.

When *Use Post-String* bit is set, the gateway searches the message packet bytes for a match to the stored *Post-String*. If a match is not found, the message packet is ignored.

Pre-String – Required if *Use Pre-String* selected in *Receive Mode*. Enter a string of 1-9 bytes in Short_String data format, with 1st byte = string length. Example *Pre-String* is [0x01 0x41], where string length is 1 and pre-string character is 0x41 ('A')

Post-String – Required if *Use Post-String* selected in *Receive Mode*. Enter a string of 1-9 bytes in Short_String data format, with 1st byte = string length. Example *Post-String* is [0x02 0x42 0x43], where string length is 2 and post-string characters are 0x42 ('B') and 0x43 ('C')

Data Type – The gateway converts received ASCII message data into the selected data type for *Receive Data*.

Decimal	Hex.	Data Type	Date Size (byte)	Value Range
194	0xC2	SINT (signed 8-bit integer)	1	-128 ~ 127
195	0xC3	INT (signed 16-bit integer)	2	-32768 ~ 32767
198	0xC6	USINT (unsigned 8-bit integer)	1	0 ~ 255
199	0xC7	UINT (unsigned 16-bit integer)	2	0 ~ 65535
202	0xCA	REAL (32-bit floating point value)	4	±1.175E-38 ~ ±3.4028E+38
218	0xDA	Short_String	Set by data size attribute, Max. 26 bytes	

Enter number from decimal (or hex) column to select the desired data type. *Data Size* column defines the number of data bytes for *Receive Data*. For *Short_String,* set *Data Size* parameter to the desired number of data bytes (plus 1 length byte). Set the *Width* parameter to the expected number of ASCII bytes to be converted into a real or integer number.

Data Size – Required for Short_String *Data Type*. Defines the maximum number of bytes in a Short-String, plus one length byte (2-26). The first byte in a Short_String defines the string length.

The *Data Size* parameter for *Serial Receive Process* and *Serial Transmit Process* must sum to a total less than or equal to 64 bytes, regardless of whether the process is being used. Set unused process's *Data Type* parameter to USINT or SINT, which have 1-byte *Data Size*.

Width – Required for SINT, INT, USINT, UINT, REAL *Data Types*. Defines the number of ASCII bytes (1-16) to be converted into an integer or real number.

Conversion – Required for SINT, INT, USINT, UINT *Data Types*. Denotes if the ASCII bytes represent a decimal integer ('D' or 0x44) or a hexadecimal integer ('X' or 0x58).

Pad Char – Byte value to pad the RX Message bytes.

Sync Enabled – Enables receive synchronization with the user application. When enabled, the gateway will not update its *Receive Data* until the *Receive Acknowledge* bit matches the *Receive Toggle* bit. Enabling receive synchronization ensures that the user application does not miss any received message data between polls.

Serial Transmit Process Settings

This section describes how to configure the *Serial Transmit Process*.

Serial Transmit Process Parameters (Parameter Group 66, Parameter Device 1)

Number	Name	Data Type	Value
6	Transmit Mode	USINT	Bit 0 – use Data Bit 1 – use String1 before data Bit 2 – use String2 before data Bit 3 – use String1 after data Bit 4 – use String2 after data
7	String1	Short_String	String of 1-9 bytes.
8	String2	Short_String	String of 1-9 bytes.
9	Data Type	USINT	194 (0xC2) = SINT (1 byte) 195 (0xC3) = INT (2 bytes) 198 (0xC6) = USINT (1 byte) 199 (0xC7) = UINT (2 bytes) 202 (0xCA) = REAL (4 bytes) 218 (0xDA) = Short String (Data Size bytes)
10	Data Size	USINT	1-26
11	Width	USINT	1-16
12	Precision	USINT	0-6
13	Conversion	USINT	Bit 0 – hex (0 for decimal, 1 for hex) Bit 7 – use leading zeros to pad number

Transmit Mode – Defines the message packet structure to be transmitted. The message packet can consist of 5 fields – *String1 Before*, *String2 Before*, *Data*, *String1 After*, and *String2 After*. Set associated bits (0, 1, 2, 3, 4) to enable the desired fields. Set the remaining bits 5-7 to zero.

[String1 Before] [String2 Before] [Data] [String1 After] [String2 After]

String1 parameter defines the byte string for the *String1 Before* and *String1 After* fields. *Data Size* parameter defines the number of bytes expected in the *Data* field. *String2* parameter defines the byte string for the *String2 Before* and *String2 After* fields. While the *Data* field is typically selected, you can configure the gateway to transmit a predefined message using String1 and/or String2, without requiring any output data bytes from the Profibus master.

When the *String1 Before* and/or *String2 Before* bits are set, the gateway places the respective byte string(s) at the beginning of the message packet. If both options are selected, String1 is placed before String2. The gateway then loads the converted data bytes in the Data field. If the *String1 After* and/or *String2 After* bits are set, the Parameter places the respective byte string(s) at the end of the message packet. If both options are selected, then String1 is placed before String2. The message packet is then loaded into the Transmit Buffer to be sent out the serial channel.

String1 – Required if *String1 Before* or *String1 After* selected in *Transmit Mode*. Enter a string of 1-9 bytes in Short_String data format, with 1st byte = string length. Example *String1* is [0x02 0x41 0x42], where string length is 2 and post-string characters are 0x41 ('A') and 0x42 ('B').

String2 – Required if *String2 Before* or *String2 After* selected in *Transmit Mode*. Enter a string of 1-9 bytes in Short_String data format, with 1st byte = string length. Example *String2* is [0x03 0x43 0x44 0x45], where string length is 3 and post-string characters are 0x43 ('C'), 0x44 ('D'), and 0x45 ('E').

Data Type – Defines the *Transmit Data* parameter data type.

Decimal	Hex.	Data Type	Date Size (byte)	Value Range
194	0xC2	SINT (signed 8-bit integer)	1	-128 ~ 127
195	0xC3	INT (signed 16-bit integer)	2	-32768 ~ 32767
198	0xC6	USINT (unsigned 8-bit integer)	1	0 ~ 255
199	0xC7	UINT (unsigned 16-bit integer)	2	0 ~ 65535
202	0xCA	REAL (32-bit floating point value)	4	±1.175E-38 ~ ±3.4028E+38
218	0xDA	Short_String	Set by data size parameter Max. 26 bytes	

Enter number from decimal (or hex) column to select the desired data type. *Data Size* column defines the number of data bytes for *Transmit Data*. For *Short_String,* set *Data Size* parameter to the desired number of data bytes (plus 1 length byte). Set the *Width* parameter to the expected number of ASCII bytes to be converted into a real or integer number. Set the *Precision* parameter to the desired number of digits after the decimal point in a real number.

Data Size – Required for Short_String *Data Type*. Defines the maximum number of bytes in a Short-String, plus one length byte (2-26). The first byte in a Short_String defines the string length

The *Data Size* parameters for *Serial Receive Process* and *Serial Transmit Process* must sum to a total less than or equal to 64 bytes, regardless of whether the process is being used. Set unused process' *Data Type* parameters to USINT or SINT, which have a 1-byte *Data Size*.

Width – Required for SINT, INT, USINT, UINT, REAL *Data Types*. Defines the number of ASCII bytes (1-16) that will represent the integer or real number.

Precision – Required for REAL *Data Type*. Defines the number of digits (0 to 6) after the real number decimal point. Gateway adds trailing zeros to the converted value if needed.

Conversion – Selects *Leading Zeros* and *Hex or Decimal* representation. The following are valid options for the *Conversion* byte.

bit 7	bit 0	decimal	hex	description
0	0	0	0x00	no leading zeros, decimal integer
0	1	1	0x01	no leading zeros, hexadecimal integer
1	0	128	0x80	leading zeros, decimal integer
1	1	129	0x81	leading zeros, hexadecimal integer

When bit 0 = 0, the ASCII bytes represent the *Transmit Data* integer number in a decimal format. When bit 0 = 1, the ASCII bytes represent the integer number in a hexadecimal format. This bit only applies to SINT, INT, USINT, and UINT Data Types.

When bit 7 = 1, leading zeros are added to real and integer numbers as needed to match the *Width* setting. This bit only applies to SINT, INT, USINT, UINT, and REAL Data Types.

Configure Profibus Master

You must calculate the number of input and output bytes required by your PFB366 configuration before you configure the Profibus master. You need to configure the Profibus master to send the specific number of output bytes, and receive the specific number of input bytes from the gateway. Once the input and output bytes are mapped in the Profibus master, the user application program will be able to read and write data values to the input and output bytes.

Three (3) or four (4) Profibus master configuration bytes specify the presence and size of the gateway's input and output data. Use 3 configuration bytes if the gateway is only used for receiving or transmitting messages. Use 4 configuration bytes if the gateway is used to both receive and transmit messages.

Connfig Byte 1	Config Byte 2	Config Byte 3	Config Byte 4

Configuration byte 1 defines the first 2 input and output bytes, used for the gateway's transmit and receive synchronization process. Its value is 0x31 (49).

0x31			

The second configuration byte defines the remaining gateway input and output data bytes. This special ID byte declares the presence of *Receive Data* input and/or *Transmit Data* output bytes. Enter 0xC0 (192) to use both *Receive Data* input bytes and *Transmit Data* output bytes. Enter 0x80 (128) to use *Transmit Data* output bytes only (no input data bytes). Enter 0x40 (64) to use *Receive Data* input bytes only (no output data bytes)

The third and fourth configuration bytes define the required number of *Receive Data* and *Transmit Data* bytes. The number of bytes specified in the configuration must be one less than the corresponding value's *Data Size.* For example, if the *Receive Data* consists of 4 input bytes, enter 3 as the *Receive Size*. If the *Transmit Data* consists of 2 output bytes, enter 1 as the *Transmit Size*. When using both *Receive Data* and *Transmit Data*, each value's size is specified in the third and fourth configuration.

Use Input & Output Data Bytes

0x31	0xC0	Receive Size	Transmit Size

Use Output Data Bytes Only

0x31	0x80	Transmit Size

Use Input Data Bytes Only

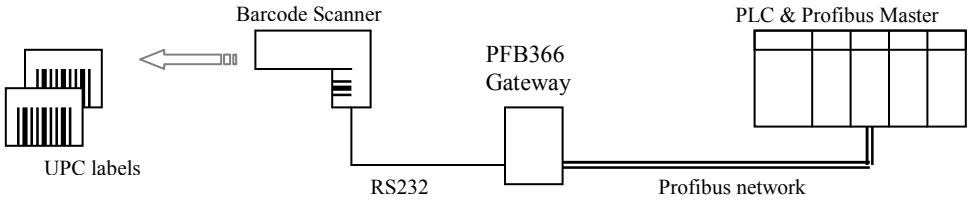
0x31	0x40	Receive Size

Chapter 5 – Configuration Examples

This chapter contains four gateway configuration examples.

Example 1 – Receiving Data

Read UPC labels into a PLC using a serial barcode scanner, a PFB366 gateway, and a Profibus master. The barcode scanner RS232 channel is connected to a PFB366 serial channel. The PFB366 Profibus channel is connected to the PLC Profibus master.



Barcode Scanner

The barcode scanner's RS232 channel is set for 9600 bps, 8 data bits, no parity, and 1 stop bit. When it reads a UPC label, it transmits the following ASCII message format. The message always begins with the ASCII STX start-of-text (0x02) character, and always ends with the ASCII ETX end-of-text (0x03) and CR carriage return (0x0D) characters. The barcode data will consist of a variable number of 1 to 12 ASCII characters, depending upon the UPC label being scanned.

[STX] [ASCII barcode data] [ETX] [CR]

PFB366 Gateway

The PFB366 gateway needs to be configured to receive this RS232 message format. The first step is to determine the *Delimiter Mode*. The barcode scanner transmits a variable-length message packet, so *Length Mode* cannot be used. *Timeout Mode* may be used, but without specific timing information for the barcode scanner's RS232 channel it may be difficult to derive a suitable *Packet Timeout* value. *List Mode* is best suited for this application, because the serial message always begins and ends with the same characters. The *Serial Stream Process* can now be configured. The following shows the *Serial Stream Process* parameter settings for this application. The 3rd column lists the parameter group/device/number/value. The last two parameters are Short_String data types.

***Serial Stream Process* Configuration (Parameter Group 64, Device 1)**

Parameter	Data	Parameter Group/Device/Number /Value	Description
3. Baud Rate	9600	0x40 0x01 0x03 0x25 0x80	9600 bps
4. Data Bits	8	0x40 0x01 0x04 0x08	8 data bits
5. Parity	0	0x40 0x01 0x05 0x00	no parity
6. Stop Bits	1	0x40 0x01 0x06 0x01	1 stop bit
7. Flow Control	2	0x40 0x01 0x07 0x02	CTS / RTS
10. Delimiter Mode	1	0x40 0x01 0x0A 0x01	List Mode
11. Pre-Delimiter String	0x01 0x02	0x40 0x01 0x0B 0x01 0x02	Short_String length = 1, STX
12. Post-Delimiter String	0x02 0x03 0x0D	0x40 0x01 0x0C 0x02 0x03 0x0D	Short_String length = 2, ETX CR

The next step is to configure the PFB366 gateway to return the ASCII barcode data to the Profibus master. Because the content of the ASCII bytes is not known, the entire byte string will be converted into a Short_String data type. The *Data Type* is Short_String, with a *Data Size* of 13 (maximum number of expected barcode data bytes is 12, plus the length byte). The *Receive Mode* is Use Data Field.

Serial Receive Process **Parameters Configuration (Parameter Group 65, Device 1)**

Parameter	Data	Parameter Group/Device/Number/Value	Description
6. Receive Mode	1	0x41 0x01 0x06 0x01	Use Data Field
9. Data Type	218	0x41 0x01 0x09 0xDA	Short_String
10. Data Size	13	0x41 0x01 0x0A 0x0D	1 length byte, 12 data bytes

The gateway will return 15 input bytes to the Profibus master. The input bytes are organized as follows:

[Transmit Acknowledge bits]	[Receive Toggle bits]	[Receive Data (Short_String)]
1 byte	1 byte	13 bytes

The gateway will always return 13 of Receive Data, even if the scanned barcode data contains fewer bytes. The application should check the Short_String length byte to determine the number of valid data bytes being returned.

Receive synchronization may also be used by enabling the *Sync Enabled* parameter.

Example 2 – Receiving Delimited Data

Using the same configuration as Example 1, the scanned UPC labels are printed in the following formats: [**MODEL xxx A**]**.** The 'xxx' are 3 ASCII characters that represent a number from 1 to 100. The gateway is configured to read this specific UPC label format, convert the ASCII characters into integer, and return them as Profibus input data.

Barcode Scanner

The barcode scanner's RS232 channel is set for 9600 bps, 8 data bits, no parity, and 1 stop bit. When it reads a UPC label, it transmits the following ASCII message format. The message always begins with the ASCII STX start-of-text (0x02) character, and always ends with the ASCII ETX end-of-text (0x03) and CR carriage return (0x0D) characters. The barcode data will consist of a variable number of ASCII characters, depending upon the UPC label being scanned.

[STX] ['MODEL xxx A'] [ETX] [CR] 14 bytes ASCII data

PFB366 Gateway

The PFB366 gateway needs to be configured to receive this RS232 message format. The first step is to determine the *Delimiter Mode*. The barcode scanner still transmits a variable length message, so *Length Mode* cannot be used. *Timeout Mode* may be used, but without specific timing information for the barcode scanner's RS232 channel it may be difficult to derive a suitable *Packet Timeout* value. *List Mode* is best suited for this application, because the serial message always begins and ends with the same characters. The *Serial Stream Process* can now be configured. The following shows the *Serial Stream Process* parameter settings for this application. The 3rd column lists the parameter group/device/number/value. The last two parameters are Short_String data types.

Serial Stream Process **Configuration (Parameter Group 64, Device 1)**

Parameter	Data	Parameter Group/Device/Number/Value	Description
3. Baud Rate	9600	0x40 0x01 0x03 0x25 0x80	9600 bps
4. Data Bits	8	0x40 0x01 0x04 0x08	8 data bits
5. Parity	0	0x40 0x01 0x05 0x00	no parity
6. Stop Bits	1	0x40 0x01 0x06 0x01	1 stop bit
7. Flow Control	2	0x40 0x01 0x07 0x02	CTS / RTS
10. Delimiter Mode	1	0x40 0x01 0x0A 0x01	List Mode
11. Pre-Delimiter String	0x01 0x02	0x40 0x01 0x0B 0x01 0x02	Short_String length = 1, STX
12. Post-Delimiter String	0x02 0x03 0x0D	0x40 0x01 0x0C 0x02 0x03 0x0D	Short_String length = 2, ETX CR

The next step is to configure the PFB366 gateway to process the label formats and convert the ASCII characters into integer numbers, to be returned as a Profibus input.

Serial Receive Process is configured to process the 11-character model number UPC label message packet. The *Receive Mode* is set to *Use Pre-String*, *Use Data*, and *Use Post-String* fields. The *Pre-String* parameter is set to 'MODEL ', and *Post-String* is set to ' A' (space and character 'A'). These two strings are used to filter for the model-number message packet. The model number range is 1 to 100, so the *Data Type* is set for USINT with a *Width* of 3, and *Conversion* is set to decimal. The *Data Size* is 1 byte for USINT.

Serial Receive Process **Parameter Configuration (Parameter Group 65, Device 1)**

Parameter	Data	Parameter Group/Device/Number/Value	Description
6. Receive Mode	7	0x41 0x01 0x06 0x07	use Data, Pre-String, Post-String fields
7. Pre-String	0x06, 'MODEL '	0x41 0x01 0x07 0x06 0x4D 0x4F 0x44 0x45 0x4C 0x20	Short_String length = 6, 'MODEL '
8. Post-String *	0x02, ' A'	0x41 0x01 0x08 0x02 0x20 0x41	Short_String length = 2, ' A'
9. Data Type	198	0x41 0x01 0x09 0xC6	USINT (8-bit unsigned integer)
11. Width	3	0x41 0x01 0x0B 0x03	3 ASCII bytes to be converted
13. Conversion	'D'	0x41 0x01 0x0D 0x44	ASCII bytes represent decimal number

*Note: The post string consists of a space character and character A.

The gateway returns 3 input bytes to the Profibus master. The data is organized as follows:

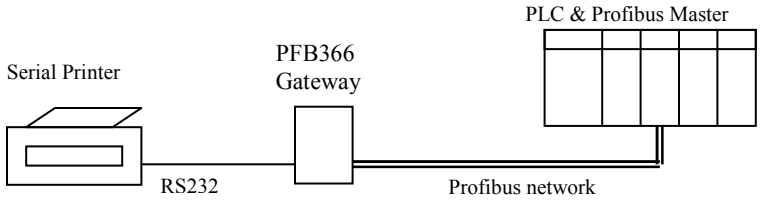
[Transmit Acknowledge bits]	[Receive Toggle bits]	[Receive Data (USINT)]
1 byte	1 byte	1 byte

The gateway is now configured to receive the barcode message packets, convert the embedded number into either an 8-bit unsigned integer number, and return it as Profibus input byte.

Receive synchronization may also be used by enabling the *Sync Enabled* parameter.

Example 3 – Transmitting Data

Print an ASCII string from a PLC to a serial printer, using a PFB366 gateway and a Profibus master. The text message string can be from 1 to 25 characters long, including any ASCII control characters. The serial printer RS232 channel is connected to a PFB366 serial channel. The PFB366 Profibus channel is connected to the PLC Profibus master.



Serial Printer

The serial printer's RS232 channel is set for 300 bps, 7 data bits, even parity, and 2 stop bits. It uses XON / XOFF software flow control.

PFB366 Gateway

The PFB366 serial channel is configured to transmit this RS232 message format. The *Serial Stream* Process parameters are shown below for this application. The 3rd column lists the parameter group/device/number.

Serial Stream Process **Configuration (Parameter Group 64, Device 1)**

Parameter	Data	Parameter Group/Device/Number/Value	Description
3. Baud Rate	300	0x40 0x01 0x03 0x01 0x2C	300 bps
4. Data Bits	7	0x40 0x01 0x04 0x07	7 data bits
5. Parity	2	0x40 0x01 0x05 0x02	Even parity
6. Stop Bits	2	0x40 0x01 0x06 0x02	2 stop bit
7. Flow Control	1	0x40 0x01 0x07 0x01	XON / XOFF

The next step is to configure the PFB366 gateway to transmit data received from the Profibus-master to the serial printer. To allow the printing of any text message, the gateway is configured to pass through the ASCII data bytes from the Profibus master to the printer. The gateway will receive a Short_String variable from the Profibus master. The *Data Type* is Short_String, with a *Data Size* of 26 (maximum text message size is 25, plus the length byte). The *Transmit Mode* is *Use Data*.

Serial Transmit Process Configuration (Parameter Group 66, Device 1)

Parameter	Data	Parameter Group/Device/Number/Value	Description
6. Transmit Mode	1	0x42 0x01 0x06 0x01	Use Data
9. Data Type	218	0x42 0x01 0x09 0xDA	Short_String
10. Data Size	26	0x42 0x01 0x0A 0x1A	1 length byte, 26 data bytes

The gateway expects to receive 28 output bytes from the Profibus master, with the data organized as follows:

[Transmit Toggle bits 0]	[Receive Acknowledge bit 0]	[Transmit Data (Short_String)]
1 byte	1 byte	26 bytes

The gateway is now configured to receive ASCII text messages up to 25 characters in length and send them to the serial printer. The Profibus master will always send 28 output bytes to the gateway, even if the text message is shorter than 25 characters. The gateway uses the Short_String length byte to determine the number of valid characters to be transmitted.

Transmit synchronization must be used by the application. The application toggles the *Transmit Toggle* bit in the first output byte, and monitors the *Transmit Acknowledge* bit in the first input byte. When the *Transmit Acknowledge* bit equals the *Transmit Toggle* bit, then the application can send the next text message.

Example 4 – Transmitting Delimited Data

Using the same configuration as Example 3, the PFB366 gateway is configured to print a pre-defined text messages and inserting an integer value into a message.

'TEMP = xxx C, xxx F', <CR>, <LF> (xxx is value, range of –50 to +400)

Serial Printer
The serial printer's RS232 channel is set for 300 bps, 7 data bits, even parity, and 2 stop bits. It uses XON / XOFF software flow control.

PFB366 Gateway
The PFB366 gateway is configured to transmit this RS232 message format. The *Serial Stream Process* parameters are shown below for this application. The 3rd column lists the parameter group/device/number/value

Serial Stream Process Configuration (Parameter Group 64, Device 1)

Parameter	Data	Parameter Group/Device/Number/Value	Description
3. Baud Rate	300	0x40 0x01 0x03 0x01 0x2C	300 bps
4. Data Bits	7	0x40 0x01 0x04 0x07	7 data bits
5. Parity	2	0x40 0x01 0x05 0x02	Even parity
6. Stop Bits	2	0x40 0x01 0x06 0x02	2 stop bit
7. Flow Control	1	0x40 0x01 0x07 0x01	XON / XOFF

The next step is to configure the PFB366 gateway to transmit the specific message.
Serial Transmit Process is configured to transmit the message. It receives an integer value from the Profibus master, converts it to 3 ASCII characters, builds a message packet, and transmits it. The *Transmit Mode* is *Use String1 Before Data*, *Use Data*, and *Use String2 After Data*. *String1* is ['TEMP = ']. String2 is [' C, ']. The *Data Type* is INT, to cover the –50 to 400 range. The *Width* is 3, and the *Conversion* is set for decimal with no leading zeros.

***Serial Transmit Process* Configuration (Parameter Group 66, Device 1)**

Parameter	Data	Parameter Group/Device/Number/Value	Description
6. Transmit Mode	19	0x42 0x01 0x06 0x13	Use Data, String1 Before, String2 After
7. String1	0x07, 'TEMP = '	0x42 0x01 0x07 0x07 0x54 0x45 0x4D 0x50 0x20 0x3D 0x20	Short String length = 7, 'TEMP = '
8. String2	0x04, ' C, ' CR LF	0x42 0x01 0x08 0x04 0x20 0x43 0x0D 0x0A	Short String length = 4, ' C, ' CR LF
9. Data Type	195	0x42 0x01 0x09 0xC3	INT (16-bit signed integer)
11. Width	3	0x42 0x01 0x0B 0x03	convert to 3 ASCII bytes
13. Conversion	1	0x42 0x01 0x0D 0x01	represent integer in decimal

The gateway expects to receive 3 output bytes from the Profibus master with the data organized as follows:

[TX Toggle (bit 0)]	[RX Acknowledge (bit 0)]	[Transmit Data (UINT)]
1 byte	1 byte	1 byte

Transmit synchronization must be used. The application toggles the *Transmit Toggle* bit when it sends new temperature values, and monitors *Transmit Acknowledge* bit to tell when the message has been sent.

Chapter 6 – Troubleshooting

Problem	Possible Cause
Profibus Configuration Program does not recognize Gateway.	• Register Gateway GSD file with Configuration Program.
Profibus Configuration Program does not recognize Gateway after loading GSD file.	• Check Major and Minor Revisions for Gateway and GSD file, to see if you have correct GSD file for your Gateway's firmware version.
Gateway does not appear on Profibus network.	• Check wiring and cable connections. • Check gateway power supply voltage. • Make sure Gateway baud rate matches network baud rate. • Verify Gateway Node Address is set from rotary switches or retentive memory. • Make sure Gateway Node Address is not used by another device.
After setting Gateway Node Address, Profibus Master does not recognize Gateway.	• Disconnect Gateway from network before changing Node Address. • Make sure Gateway NODE ADDRESS is not used by another device. • Verify Gateway NODE ADDRESS is set from rotary switches or retentive memory value. • Verify gateway supports Profibus baud rate.
NET LED is off or flashing green.	• Gateway is in Wait Parameter/Configuration State. Download PFB366 parameters using Profibus Configuration Tool.
MOD LED is off.	• Gateway is not powered. Check power supply and cable connection.
MOD LED is solid red	• Gateway is searching for Profibus baud rate. Make sure Profibus netword is configured to baud rate supported by gateway.
RX LED does not flash green when data is sent to the Gateway.	• If Sync Enabled, make sure Receive Toggle and Receive Acknowledge bits are being toggled. If application does not toggle Receive Acknowledge, Gateway will not receive data. • Verify source device is transmitting data to Gateway.
RX LED is solid red after Gateway receives data.	• Check extended diagnostics byte for RX buffer Overflow or parity Error. Reset gateway to clear errors. • Make sure parity is set to match transmitting device.
TX LED is solid red after receiving data from Profibus Master.	• Check extended diagnostic byte for TX buffer Overflow or Parity Error. Reset Gateway or clear Serial Status error bit if necessary. • Make sure parity is set to match transmitting device.
TX LED does not flash green when Gateway should be transmitting data.	• If Sync Enabled, make sure Transmit Toggle is being toggled. If application does not toggle Transmit Toggle, Gateway will not transmit data.

The slave contains diagnostic data showing the current state and any error that may have occurred. Among the first six bytes is the station status, shich displays the status and any fault of the slave, including: if watchdog, freeze mode, and sync mode are enabled, extended or static diagnostic exist, the slave is activated, or any parameter/configuration fault occurred. For example, if Serial Receive/Transmit LEDs turn solid red, check the extended diagnostics message to determine what type of error occurred. The length of error message is shown in the seventh byte and the actual error data begins at the eight byte.

Slave Single Diagnostic

Station Status 1	**Station Status 2**	**Station Status 3**	**Master Address**	**Indent …**	**… Number**	**Length of Ext Diag**	**Extended Diagnostics**

Extended Diagnostic Byte

Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit1**	**Bit 0**
Reserved	**Reserved**	**Reserved**	**Error 3**	**Reserved**	**Reserved**	**Error 2**	**Error 1**

Error 1: Serial Receive FIFO Overrun – buffer filled beyond maximum capability.
Error 2: Serial Receive Parity Error
Error 3: Serial Transmit FIFO overrun – buffer filled beyond maximum capability

Appendix A – Product Specifications

Profibus Interface

Isolation:	500 Volts
Reverse Polarity:	-30 Vdc
Signal Levels:	RS485
Supported Baud Rates:	9600, 19.2K, 93.75K, 187.5K, 500K, 1.5M, 3M (auto baud)

Serial Channel

Power Requirements:	11 - 28 Vdc @ 50 mA
ESD Protection:	+/- 10 kV
Overload Protection:	+/- 30 Volts
Short Circuit:	Indefinite
RS232 Output Levels:	+/- 7.9 Volts (unloaded, typical)

Environmental

Operating Temperature:	0^{o} C to 70^{o} C
Storage Temperature:	-25^{o} C to 85^{o} C
Size (inches):	3.25 x 2.37 x 1.08
Mounting (inches)	0.5 tabs, 3/16 diameter mounting holes
PCB Encapsulation:	RTV Silicon Compound

Appendix B – Profibus Parameter Template

Group	Device	Number	Default	Setting	Unit	Comments

Appendix C – ASCII Character Codes

Non-Printable Characters					Printable Characters								
Hex	Dec	Char	Name	Kybd	Hex	Dec	Char	Hex	Dec	Char	Hex	Dec	Char
0x00	0	NUL	Null	Ctrl @	0x20	32	Space	0x40	64	@	0x60	96	`
0x01	1	SOH	Start of heading	Ctrl A	0x21	33	!	0x41	65	A	0x61	97	a
0x02	2	STX	Start of text	Ctrl B	0x22	34	"	0x42	66	B	0x62	98	b
0x03	3	ETX	End of text	Ctrl C	0x23	35	#	0x43	67	C	0x63	99	c
0x04	4	EOT	End of transmit	Ctrl D	0x24	36	$	0x44	68	D	0x64	100	d
0x05	5	ENQ	Enquiry	Ctrl E	0x25	37	%	0x45	69	E	0x65	101	e
0x06	6	ACK	Acknowledge	Ctrl F	0x26	38	&	0x46	70	F	0x66	102	f
0x07	7	BEL	Bell	Ctrl G	0x27	39	'	0x47	71	G	0x67	103	g
0x08	8	BS	Backspace	Ctrl H	0x28	40	(	0x48	72	H	0x68	104	h
0x09	9	HT	Horizontal tab	Ctrl I	0x29	41	)	0x49	73	I	0x69	105	i
0x0A	10	LF	Line feed	Ctrl J	0x2A	42	*	0x4A	74	J	0x6A	106	j
0x0B	11	VT	Vertical tab	Ctrl K	0x2B	43	+	0x4B	75	K	0x6B	107	k
0x0C	12	FF	Form feed	Ctrl L	0x2C	44	,	0x4C	76	L	0x6C	108	l
0x0D	13	CR	Carriage return	Ctrl M	0x2D	45	-	0x4D	77	M	0x6D	109	m
0x0E	14	SO	Shift out	Ctrl N	0x2E	46	.	0x4E	78	N	0x6E	110	n
0x0F	15	SI	Shift in	Ctrl O	0x2F	47	/	0x4F	79	O	0x6F	111	o
0x10	16	DLE	Data line escape	Ctrl P	0x30	48	0	0x50	80	P	0x70	112	p
0x11	17	DC1	Device control 1	Ctrl Q	0x31	49	1	0x51	81	Q	0x71	113	q
0x12	18	DC2	Device control 2	Ctrl R	0x32	50	2	0x52	82	R	0x72	114	r
0x13	19	DC3	Device control 3	Ctrl S	0x33	51	3	0x53	83	S	0x73	115	s
0x14	20	DC4	Device control 4	Ctrl T	0x34	52	4	0x54	84	T	0x74	116	t
0x15	21	NAK	Negative acknowledge	Ctrl U	0x35	53	5	0x55	85	U	0x75	117	u
0x16	22	SYN	Synchronous idle	Ctrl V	0x36	53	6	0x56	86	V	0x76	118	v
0x17	23	ETB	End of transmit block	Ctrl W	0x37	55	7	0x57	87	W	0x77	119	w
0x18	24	CAN	Cancel	Ctrl X	0x38	56	8	0x58	88	X	0x78	120	x
0x19	25	EM	End of medium	Ctrl Y	0x39	57	9	0x59	89	Y	0x79	121	y
0x1A	26	SUB	Substitute	Ctrl Z	0x3A	58	:	0x5A	90	Z	0x7A	122	z
0x1B	27	ESC	Escape	Ctrl [	0x3B	59	;	0x5B	91	[	0x7B	123	{
0x1C	28	FS	File separator	Ctrl \	0x3C	60	<	0x5C	92	\	0x7C	124	|
0x1D	29	GS	Group separator	Ctrl]	0x3D	61	=	0x5D	93	]	0x7D	125	}
0x1E	30	RS	Record separator	Ctrl ^	0x3E	62	>	0x5E	94	^	0x7E	126	~
0x1F	31	US	Unit separator	Ctrl _	0x3F	63	?	0x5F	95	_	0x7F	127	DEL